# Software Defined Amateur Radio: Pluses and Minuses

By Kirk A. Kleinschmidt NT0Z

Superhet designs, once thought to be unbeatable and ever-enduring, have been handily eclipsed by software-defined radio (SDR) technology, which is now sweeping across the landscape.

Well into its adolescence, SDR has already taken the performance and cost crowns, and once manufacturing, economy of scale and ergonomics push HF SDR into young adulthood (it's already there in cellular, military, computer and satellite applications), it will likely be the *only* flavor of radio commercially available, save for home-brew designs and the odd holdout.

This edition of the Radio Buyer's Guide looks at amateur radio SDR technology and the current crop of SDRs, from über-expensive, direct-sampling powerhouses to $15 USB dongles. SWLs? This concerns you, too!

Using SDRs can be quite different from using conventional ham rigs, but unless you're willing to spend nearly $20,000 for Hilberling's exotic PT-8000A (probably the last high-performance, analog superhet that will ever be manufactured), SDR performance is undisputed. The chart at Sherwood Engineering (**www.sherweng.com/table.html**), a manufacturer-independent testing lab, tells the tale and ranks the performance of many ham and SWL rigs (past and present).

Note that the chart is sorted on "dynamic range at 2-kHz signal spacing" (the ability of the radio to receive weak desired signals that are only 2 kHz away from strong unwanted signals). Other than the limited-availability Hilberling, SDRs dominate. Notably missing are Flex-Radio's 6000-series direct-sampling models (shipping in limited quantities with beta software at press time) and Apache Labs' ANAN-series radios (not yet tested at press time).

## SDR: Advancing the Art

In a superhet, incoming radio signals are mixed with a locally generated signal (VFO) and converted to an *intermediate frequency* (IF), at which filtering, amplification and other functions take place, *before* the IF signal is itself mixed with another local signal (BFO) and converted to audio, which we can hear. The performance of the mixers, crystal filters and RF amplifiers in the IF must be top-notch, which is difficult and expensive.

Direct-conversion receivers (DC), much simpler than superhets, mix incoming radio signals with a locally generated signal (VFO) and convert the resulting "0-Hz IF signal" directly to audio (baseband). Many simple home-brew receivers use direct conversion, as do most SDRs. Surprise!

First-generation SDRs use DC receiver circuits that output a pair of baseband signals (from dc to 200 kHz or so, including the audible range) that have a specific phase relationship. These audio signals, called I and Q, are fed into a PC sound card (high performance is desirable) where they're converted into digital signals by the card's analog-to-digital converters (ADCs). The card's digital signal processor (DSP) can then perform all of the functions normally performed by superhet analog circuits (amplification, detection, AGC, demodulation, filtering, limiting, etc), plus noise reduction and blanking, binaural audio, digital-mode demodulation, and more. Sophisticated PC software runs the show, so a fast PC is always required, even for basic radio operation.

The dynamic range of the sound card's ADCs and DSPs essentially determines the dynamic range of the receiver, so even if the receiver has only a few "real" parts, it can still offer very high performance! The pioneering FlexRadio SDR-1000 uses this approach, as do many home-brew and kit SDRs. Audiophile sound cards work best (they're expensive!), but almost any PC sound card will work. This architecture is called QSD/QSE, short for Quadrature Sampling Detector (receivers) and Quadrature Sampling Exciter (transmitters).

At the next evolutionary step, SDRs still use direct-conversion, QSD/QSE designs, but incorporate the "sound card ADC/DSP" into the radio and connect it to the PC (and the SDR control software) via Firewire or USB. This simplifies things and allows for tiny radios, but keeping critical software/hardware timing synchronized on each end of the connecting cable can sometimes be challenging. FlexRadio 1500- and 3000-series transceivers use this approach.

The latest generational designs put the DSP/SDR hardware *and the computer itself* inside the radio (not a general-purpose PC, but a dedicated platform designed *only* to run the SDR/DSP hardware and operating system at *stunningly high* performance levels). This approach allows SDRs to have physical knobs and switches and supports designs that don't need external PCs at all (this is potentially important). Many new SDRs use ADC/DSP hardware that can "directly sample" the RF signals being received without first converting them to baseband. This requires fast, digital processing at RF (not just from dc to 200 kHz).

This latest-gen SDR technology is called DDC/DUC, short for Direct Down Conversion (receivers) and Direct Up Conversion (transmitters) and is the likely future of all commercially made radios, amateur and otherwise. Today's DDC/DUC transceivers are still somewhat expensive ($900 to $10,000 and beyond). But, if they follow in the path of cell phone SDRs, they'll soon be "peanuts." Direct-sampling amateur radio transceivers have just become available, but at press time, shipping delays and "vaporware" issues are still slowing adoption.

DDC/DUC technology ushers in never-before-seen capabilities, including models that can continuously receive and record the *entire* HF spectrum (or smaller, more manageable swaths); models that feature eight full-performance; independent receivers that can simultaneously receive on single or multiple bands (serving multiple human operators logged on from separate networked PCs), and more.

## Using SDRs: The PC Perspective

Most SDRs require PCs to function, and fast, modern computers are almost always preferred, but many radios have specific requirements, so it's *important* to check these out ahead of time. Some SDR software runs in Linux and OSX, but most requires Windows (sometimes XP or Windows 7).

Basic SDRs prefer (or require) high-performance sound cards (or SDR-oriented

***Flex Radio Systems Flex-6500-6700 Limited Edition (Courtesy: Flex Radio Systems)***

codec cards), internal or external. Some models require Firewire or USB ports that meet certain performance requirements, but don't need sound cards because the equivalent hardware is built in. Many latest-gen models require proprietary software, but may need less-powerful PCs because the heavy lifting is done by the radio's internal processors (FlexRadio 6000-series, for example). Newer models also connect to the outside world via Ethernet, which may allow operation from computers, tablets or smart phones.

## Pros

SDRs offer many features that superhets can't offer, the most important of which is "point and click" tuning and graphical spectrum displays. "Seeing" signals up and down any particular band is a tremendous leap forward, and when you see an interesting signal, you can simply click on it with your mouse pointer to tune it in—no more Flat Earth!

SDRs typically have "crunch proof" receivers that are a joy to use on crowded bands stuffed with big signals. They also offer an infinite variety of "brick wall" filters, unlike superhets, which offer only a few (or one). Digital SDR filters don't ring or sound mushy, even at 100-Hz bandwidths. You can tune in a weak CQ right next to a powerhouse ragchew, select a narrow filter and you'll never even know the "unwanted" signal is nearby. That ability is a game-changer. Other digital features include noise-reduction, notch filters, binaural reception, RX and TX audio equalization, and much more.

## Cons

New technologies have rough edges, and SDRs aren't exempt. PC-based SDRs need PCs, of course, which limits their flexibility and portability. SDR transceivers can be difficult to connect and configure (receivers less so). Although newer PC-based models don't require complicated sound card interconnects, SDR software still has *lots* of settings that can (or need to) be tweaked. PC-based SDRs aren't yet "plug and play," so compu-phobes should choose carefully!

Despite their unparalleled graphical displays, flexibility and performance, the ergonomics of actually using PC-based SDRs on the air can be frustrating, especially if you're used to physical knobs and switches. Getting SDR software to cooperate with logbooks, contesting software, digital-mode controllers, CW and voice keyers, etc, can be frustrating, difficult or impossible. Success can require extreme multitasking, the use of multiple monitors, and complex configuration schemes that map virtual COM ports and require internal audio redirects. The latest designs may offer some improvements, but it's too early to be sure.

When using PC-based setups it can be difficult or impossible to tune or control your SDR in any way when the mouse pointer is "focused" on your logbook or digital-mode software. Clicking back and forth between SDR and contest software windows, for example, even if each is displayed on a different monitor, can require lots of mouse hand gymnastics and back-and-forth clicking *for every QSO*. That's why most radio contesters still don't use SDRs.

## Software

PC-based SDRs require software to function, and although some models support a wide variety of open-source or free SDR software, many models require specific or proprietary software to function at all. If your favorite PC/operating system can't support your SDR, it won't work, so be careful (or consider an SDR that doesn't require a PC).

SDR software comes in two main flavors: computer software that speaks radio, and radio software that speaks computer. The first is designed by programmers and, while offering fantastic performance, has little radio "feel." The second is designed by radio users and, while offering a similar set of computerized goodness, still "feels" like you're using a ham or SWL radio, and the layout and relationship of the controls makes sense to ops used to using physical radios. Each software type can be awesome, but your expectations and usage scenarios must match your "software design orientation" or the whole experience will seem extra awkward!

## SDR Buyer's Guide

SDR technology is exploding globally, and that fact is reflected in the sheer number of SDR transceivers available as kits, semi-kits and fully assembled radios. Space here is limited, so we apologize for those models we couldn't include. Many kit radios require a wide range of skills to successfully assemble (some easy, some extreme), so make sure you're up to the task or have sufficient help lined up before getting started.

## Sound Card-Based SDRs

These basic radios require high-performance sound cards (or other ADC/DSP hardware) and fast PCs running SDR software (many flavors are available, most are free). A high-performance stereo sound card is required for RX, and a *second* stereo card (not so high performance) is required for TX. Some high-end (expensive) sound devices are *full duplex*, supporting two or more simultaneous stereo signal paths. To save money, many ops use a "good" internal sound card for RX and an "inexpensive" external USB sound device (or dongle) for TX.

Most QSD/QSE rigs that share this "external sound card(s) required" architecture (such as the pioneering FlexRadio SDR-1000) are now kits, as mainstream manufacturers have generally moved their designs forward. Sound card rigs are still heard on the air every day, however, and are great platforms for exploring and experimenting. When paired with high-end sound cards, even simple SDRs can offer outstanding performance. Assembly, setup and interconnections can be challenging, however, so they're not recommended for non-technical types!

**Softrock RXTX Ensemble**: KIT or ASSEMBLED, $, GOOD, MT-PICK. This 1-W, multimode SDR transceiver can be built for full coverage of one of the following five band

*Softrock RX/TX Ensemble (Courtesy: Softrock SDR)*

### SDRS THAT AREN'T?

Because we're in an "SDR transition" of sorts, some ops are confusing software-controlled radios with software-defined radios. This is evident on Internet forums and even in print. The simplest way to differentiate between SCRs and SDRs is to remember that, in SDRs, the "software" handles the tasks that would have previously been performed by hardware devices such as mixers, filters, demodulators, etc. Most superhet radios made in the past 20 years can be interfaced with computers for control of most (or all) internal functions, remote access, etc., but conventional circuits still "do the work."

Some SCRs *seem a lot like* SDRs. Ten-Tec's RX-320D, for example, a "black box radio" without any physical controls that uses a PC to control all functions, has a certain amount of DSP functionality built in, but the core circuits are conventional. The Kachina 505 and Ten-Tec's Pegasus pioneered this in the amateur market. Kenwood's TS-B2000, the black box version of the TS-2000, has no physical controls, but it's not an SDR. Ten-Tec's new 506 Rebel, an "open-source," experimenter-friendly, two-band QRP transceiver, has an Arduino-based architecture that's designed to easily be changed, adapted and modified by users, is also not an SDR. Its direct-digital-synthesis (DDS) "VFO" is Arduino-controlled, but the "radio" circuits are conventional.These are fine radios, but if you're searching for an SDR, be sure to verify a PC-friendly radio's underlying architecture!

*Ten-Tec Rebel (Courtesy: Ten-Tec)*

## A $20 SDR ON A STICK?

If only to prove the power and potential of inexpensive future SDR systems, check out the "DVB Dongle Craze" and you'll be amazed by how much radio you can buy for less than $20!

Powered by the USB port on your PC and about the size of a USB thumb drive, "DVB-T dongles" are SDR "systems on a stick" that were designed to receive digital television signals overseas. To the delight of hams and SWLs everywhere, developer Antti Palosaari discovered that the DVB dongles could be used with free software to make decent, dirt-cheap, all-mode SDRs that cover 25-2200 MHz! Add a similarly priced HF converter and you have a $40 dc-to-daylight SDR that can receive all modes and display a 2-MHz-wide swath of RF on its PC-based band scope!

At press time, the preferred dongles, usually sourced on eBay, pair a Realtek 2832U quadrature sampling detector with Elonics E4000 or Rafael Micro R820T tuners (other combos may not work). The stick radios have an antenna connector on one end and a USB connector on the other. RF signals go in one side and raw I/Q data goes out the other, to the PC, where a variety of powerful, free software makes the magic happen.

Unlike conventional designs, SDR dongles can receive AM, AM-synchronous, FM (wide and narrow), USB, LSB, ISB, DSB, CW – all the modes we know and love. Plus, support is emerging for obscure modes such as APCO 25, INMARSAT, ADS-B, and more.

While these powerful little radios aren't yet polished (they will be soon), they're practically free and are perfect for experimenters and computer enthusiasts. It does take some fiddling to get the software set up, and with only a 50-dB dynamic range, if you connect yours to a giant external HF antenna, for example, you may receive all bands at once! External RF attenuation or band-pass filters may be required to avoid interference or distortion.

Similarly, if you only connect the tiny whip antenna that accompanies these units, you won't receive much more than the RF noises from your PC, fluorescent lights and household appliances. Using them with companion transmitters is awkward at best, but low-cost transceiver designs inspired by these dongles are already being tested. Start at **http://sdr.osmocom.org/trac/wiki/rtl-sdr** and Google as necessary. *MT*'s June, 2013, "On the Ham Bands" column has more info.

groups: 160; 80-40; 40-30-20; 30-20-17;15-12-10. Components are included for all five options; you choose prior to assembly. The circuit board, which measures 5 x 2.5 inches, has mostly surface-mount parts, so SMT soldering experience—or a willingness to dive in—is a must. The venerable rig, available in several versions over the years, was designed by Tony Parks KB9YIG, the "father of affordable SDR experimentation." Softrocks work with a wide variety of software and enjoys a strong online support community and an active user base. The RXTX Ensemble is probably the least expensive "full-performance" SDR transceiver. Prices: $89 (kit); $124 (assembled). Both are available factory-direct at **http://fivedash.com**.

**GenesisRadio G11**: KIT, $$, BETTER. The basic kit, a 10-W, multimode SDR transceiver, can be built for full coverage of two to five ham bands from 160-6 meters, and an add-on kit enables all-band coverage (160-6) and general-coverage receive. All 600+ surface-mount components are factory installed and the remaining 60 through-hole parts take about eight hours to assemble. The G11 requires GenesisRadio's proprietary software, *GSDR*, to operate, and the radio has a dedicated following and a healthy online support community. Prices: $299 (basic kit); $139 (all-band filter add-on); $60 (enclosure); $435 (kit + all-band filter add-on); $480 (kit, all-band filters, enclosure). See **www.genesisradio.com**.au and **www.greenmountainradio.com/G11/order.html** for more info.

***Genesis G11 SDR transceiver (Courtesy: Genesis Radio)***

## USB/Firewire SDRs

With built-in "sound cards" (ADCs), second-generation SDRs require reasonably fast PCs outfitted with Firewire and/or USB ports that meet certain performance specs and run proprietary SDR software (FlexRadio's *PowerSDR* for these two models). Although still QSD/QSE designs, second-generation SDRs generally offer improved performance, fewer connections and are generally much easier to get up and running. Surprisingly, FlexRadio recently retired its former flagship, the FLEX-5000A, because of parts unavailability and the introduction of the company's new 6000-series models.

***Terratec SDR Dongle (Courtesy: Terratec)***

**FlexRadio FLEX-1500**: ASSEMBLED, $$$, GOOD, MT-PICK. This 5-W, HF+6 multimode transceiver (RX 0.01-54 MHz) can put out as little as 1 mW and is designed to also work as an IF deck for external VHF/UHF/microwave transverters. Features: 48-kHz-wide panoramic band scope display with point-and-click tuning, sophisticated

***Flex Radio Systems Flex-1500 (Courtesy: Flex Radio Systems)***

DSP filters, noise-reduction, advanced AGC, and very high RF performance for its price. It outperforms previous-generation superhets costing many times more and sits surprisingly near the top of the Sherwood Engineering receiver performance charts. A full feature matrix can be found at **www.flex-radio.com**. The tiny and versatile FLEX-1500 is the most affordable way to get your feet wet with a commercially made, second-generation SDR. The '1500 requires a Windows PC with high-performance, low-latency USB ports (often easier to find on older PCs than on new!). Some users experience T/R and keying issues related to USB implementation. Available factory-direct for $699 from www.flex-radio.com.

**FlexRadio FLEX-3000**: ASSEMBLED, $$$$, BEST. This 100-W, HF+6 multimode transceiver (RX 0.01-65 MHz) can't juggle transverters like its little brother, but the "Workhorse 3000" boasts better specs in every critical subsystem, including a 96-kHz-wide spectrum display and a Firewire PC interface that eliminates the USB connectivity problems that affect many FLEX-1500 users. A full feature matrix can be found at **www.flex-radio.com**. Available factory-direct for $1749.

***Flex Radio Systems Flex-3000 (Courtesy: Flex Radio Systems)***

## DDC/DUC SDRs

Most latest-generation, direct-sampling SDRs are so new that they've just begun shipping (some in limited quantities and some with beta software). They offer (or promise) unbeatable RF performance and never-before-seen capabilities, but they're not mature and don't have a track record. For connectivity, the new radios rely on Ethernet, which dramatically outclasses USB or Firewire. DDC/DUC technology is *rapidly* evolving, so these initial models have the potential to be replaced or become obsolete fairly quickly, so do your homework.

**FlexRadio FLEX-6500**: ASSEMBLED, $$$$, BEST (expected rating, not shipping in quantity at press time, software still in beta). This 100-W, HF+6 multimode transceiver (RX 0.03-77 MHz), intended to be a dramatic step forward in transceiver design, is powered by FlexRadio's next-gen *SmartSDR* software.

The '6500's internal FPGAs and digital hardware (dedicated computing platform) promises digital-radio number crunching on par with an 8-core Intel CPU with 100% load on all cores!

The '6500 provides every existing SDR function, plus: four independent, full-performance receivers (anywhere in the 0.03-77 MHz range), each with 384-kHz-wide spectrum displays; promised receiver dynamic performance so high "it no longer matters," (FlexRadio brochure, public lab tests forthcoming) and may not even be measurable by most labs; multiple antenna and XVTR ports; digital QSK; GPS Disciplined Oscillators (GPSDO, add-on) for lab-grade frequency accuracy; Gigabit Ethernet interface with future WAN/internet connectivity (simultaneous remote operation by multiple users); and enough built-in smarts to intelligently control, monitor and interface with external amplifiers, tuners, rotators, antennas, etc. For a comprehensive feature list or to order factory-direct, see **www.flexradio.com**. Prices: $4,300 (radio), $699 (GPSDO add-on).

**FlexRadio FLEX-6700**: ASSEMBLED, $$$$$, BEST (expected rating, not shipping in quantity at press time, software still in beta). This 100-W, HF+6 multimode transceiver (RX 0.03-77 and 135-165 MHz) is similar to its little brother, but packs more number-crunching power, up to eight independent receivers, coverage of 135-165 MHz (RX on any antenna port, TX via XVTR ports). For a comprehensive feature list or to order factory-direct, see **www.flexradio.com**. Prices: $7,500 (radio), $699 (GPSDO add-on).

**Apache Labs ANAN-100/D**: ASSEMBLED, $$$$, BEST (expected rating). This 100-W, HF+6 multimode transceiver (RX 0.01-55 MHz) is a 4th-generation, cooperatively developed design based on the OpenHPSDR Hermes SDR. The 100/D can simultaneously support four to seven full-performance receivers, each with 384-kHz spectrum displays; claimed dynamic range of 125 dB; multiple antenna and XVTR ports; digital QSK; lab-grade frequency accuracy; Gigabit Ethernet interface to support simultaneous remote operation by multiple users; and more. Supported by various SDR software for Windows, Linux and OSX, Apache Labs recommends fast, modern PCs for best results. For a comprehensive feature list or to order factory-direct, see **https://apache-labs.com**. Prices: $3,489 (ANAN-100/D); $2,489 (ANAN-100); $1,679 (ANAN-10, 10-W version).

*Apache Labs ANAN 10 (Courtesy: Apache Labs)*

## Standalone SDRs

Most SDRs require PCs, but it's a design choice, not a necessity. As mentioned, most of today's top-performing hybrid superhet radios incorporate SDRs internally, but don't necessarily say so. The following standalone SDRs, which *do not* require external PCs, are likely blazing a trail that will become well-worn in the future.

**Midnight Design Solutions SDR Cube**: KIT or ASSEMBLED, $$$, GOOD. This 1-W, single-band (80, 40, 30, 20 or 17 meters), multimode HF transceiver is a flexible, self-contained QSD/QSE radio that doesn't require a PC. At only four inches square, the SDR Cube pairs a Softrock SDR transceiver board (built-in or external) with a dedicated DSP controller and a full-featured "front panel" – complete with knobs, switches an LCD frequency readout, and an 8-kHz-wide spectrum display. Add plenty of I/O connectors, experimenter-friendly firmware and an active support community and you've got a platform for SDR fun and innovation – no PC required. See the complete list of goodies, including the new general-coverage RX module, and order factory-direct at **www.sdr-cube.com**. Prices: $575 (assembled and tested); $416 (assembled and tested, you supply your own Softrock SDR board); $339 (full kit); $241 (you supply your own Softrock SDR board); $31 (PCBs only).

*SDR Cube (Courtsy: Midnight Design Solutions)*

**Elecraft KX3**: ASSEMBLED or KIT, $$$, BEST, MT-PICK. This 10-W, multimode, HF+6 transceiver (RX 0.5-30 MHz) would be a remarkable achievement at several times the price. About the size of a house brick and weighing 1.5 pounds, the trail friendly KX3 is a competition-grade, "do everything" SDR for home or field use. At press time the KX3 is ranked second on the Sherwood Engineering Receiver Performance Chart (**www.sherweng.com/table.html**) when compared to *every radio the lab has ever tested*, regardless of price or size (104 dB dynamic range at 2-kHz signal spacing). The only radio to yet best it, the exotic Hilberling PT-8000A, is 20 times the size and costs nearly 20 times as much!

*Elecraft KX3 (Courtesy: Elecraft)*

This tiny powerhouse has a full complement of knobs, switches, displays and I/O connectors – it's a standalone radio, no PC required – but includes I/Q quadrature audio outputs for easy PC/tablet spectrum display connections (and is fully PC-controllable via the usual CAT commands). To many ops this provides the best of both worlds: a conventional radio with knobs and switches with the hi-res spectrum display of an SDR. The 10-W "base model" starts at $899, and a large assortment of add-ons allows you to create a custom radio over time. It's too tiny for some users, but it's a Ferrari for the price of a scooter! The KX3 is available factory-direct from **http://elecraft.com**. Prices: $899 (modular kit); $999 (assembled); $169 (internal wide-range ATU); $699 (matching 100-W amplifier); (internal 2-meter module coming Q1 2014).

*Apache Labs SDR Transceiver (Courtesy: Apache Labs)*

# Invasion of the Chinese Radios

by Mark Haverstock K8MSH
(Photos courtesy of the author, except where noted)

Back in the 1950s, when I was a kid, the phrase, "Made in Japan," meant cheaply constructed products at a cheap price. By the 1970s, this reputation had changed radically; people actually sought out Japanese products because they were manufactured to high standards and under strict quality control. Electronics, such as home audio products and ham radio equipment, had risen to a level of quality that rivaled or even exceeded those made in the U.S.

Now China is coming close to where Japan was in the 1970s, producing inexpensive electronics that seem to be getting better every year. Among these are the new crop of bargain handie-talkies that have been appearing under the label of dual band commercial radios, ones that coincidentally cover the ham bands as well.

Prices are unbelievably low, compared to handhelds made by the "big three," Yaesu, Icom and Kenwood. They do vary considerably, and generally are cheaper from online storefronts; especially those websites based in China. For example, the miniature Baofeng UV-3R, a 2-watt, dual-band UHF/VHF, with drop-in charger and earphone/mic accessory, currently costs $35 (including shipping from Asia!) from several online dealers. For an extra $5, you can move up to a 5-watt UV-5R, which also includes a front panel keypad for manual programming and control.

Typically, these import radios are found at many amateur radio dealers, on eBay, Amazon.com, Rakuten.com, New Egg and other online dealers. They can also be ordered directly from Asia at such websites as 409shop.com, Radioshop888 and others. Alex Lentini, president of Lentini Communications, says, "We now handle the TDXone, TYT and Wouxun brands. Sales volume has dropped somewhat, but these still sell better for me than the major brands." Brisk sales at the 2013 Dayton Hamvention seem to confirm their continuing popularity.

***Baofeng UV3R ($35 online),Baofeng's most inexpensive and popular miniature radio. This Mark II release of the original 3R has a dual-frequency display and continues to be a big seller.***

## Quality Control

You get what you pay for. When it comes to build quality, the earlier models seemed a bit rough around the edges and lacked some of the amenities of those made by the mainstream manufacturers. Materials do not appear to be as durable, and controls could be awkward and confusing. As for functionality, most perform acceptably well; providing good transmit and receive audio.

Kevin Karanmanos, director of sales and marketing for Powerwerx, previously worked for Yaesu and did a lot of their importing. "What I can tell you is Yaesu, Icom, Kenwood and Motorola, make a lot of their radios in China," he says, "People have no clue." However, the specs to which these mainstream radios have been manufactured are considerably higher than the Baofeng, TYT, Wouxon and other Chinese brands.

The consensus among dealers and users is that the Chinese are improving their products. A lot of this is a result of feedback periodically given to the manufacturers. "We have meetings with them every month, we give input from band specs to intermod levels," says Karanmanos. "They've greatly improved the last few years. We thought the radios were good two years ago, but they're even better now."

It's the importers and dealers who have become the gatekeepers when it comes to quality control for these radios, not so much the manufacturers. They are the ones testing the radios on spectrum analyzers and getting manufacturers to adjust the specs. Some are even creating their own "house brand" versions by ordering custom radios with their specifications.

***Baofeng UV-5RA ($35 online)features keypad and belt clip on radio, instead of battery pack. It meets new Part 90 requirements including narrow band capability and 2.5 kHz channel step–though these features are not required for amateur use.***

## Part 90 and Part 97 Issues

Many of the Chinese imports claim FCC Part 90 certification for the Land Mobile Radio Service. As a buyer, you should look for this Part 90 certification as being some level of quality assurance for the radio. "It tells me that, if the manufacturer can comply with Part 90, you have a reasonable chance that they are paying attention to the radio and its capability," says Dan Fish, owner of Minnesota-based Radio City.

Ed Griffin, president of Import Communications, notes that as amateur radio operators, we don't need to have certified equipment. "We can operate equipment that has certification for other services, like land mobile, as long as we are using it in a band that we're licensed to use," He says, "All the manufacturers have been applying for Part 90 certification mainly because they sell thousands of these radios that are actually used for land mobile service."

Amateur radio operators don't need FCC certification for equipment they use on the ham bands. *MT* publisher, Bob Grove W8JHD, notes, "That's how hams use old police radios on the ham bands and can even build their own transmitters."

But, it is out of courtesy for others using the radio spectrum that we make an effort to transmit a clean signal. At the recent Dayton Hamvention, the ARRL had a spectrum analyzer set up to check any radios that showed up. As you might guess, the ones that failed were mostly older releases of these import radios. According to Part 97 amateur rules, a 30-225 MHz transmitter having a mean power of 25 watts or less, the mean power of any spurious emission supplied to the antenna transmission line must not exceed 25 µW and must be at least 40 dB below the mean power of the fundamental emission, but need not be reduced below the power of 10 µW.

## Programming

Save yourself a lot of aggravation. Chinese manuals are generally poorly written and can take some patience to decipher. Instead of manual programming by keypad, buy the programming cable and use the software designed for your radio. The programming experience will go a lot more smoothly. Better yet, use Chirp (**http://chirp.danplanet.com/projects/chirp/wiki/Home**), a free, open-source program that supports most

***Accessory antennas Nagoya NA701 ($5-15 from various online dealers) and Diamond RH771 ($10-15 online)covers 136-175 MHz/400-480 MHz. Antennas like these, tuned for the amateur bands, can provide improved performance and better harmonic suppression.***